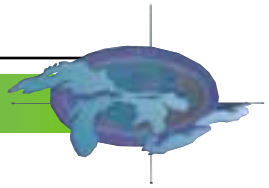


Implications for Managers

This report presents a subjective assessment, based on best professional judgment, of 33 of 80 indicators of ecosystem health. One of the objectives for using indicators to assess the status and trends of Great Lakes ecosystem components is *" . . . to strengthen the decision-making and environmental management concerning the Great Lakes."* The material presented in this report leads to certain inevitable implications for environmental and natural resource managers. These implications can be grouped into two major categories: those that relate to the development and use of indicators and those that relate to management of the Great Lakes basin ecosystem.

Indicator Development and Use

Indicator Development and Testing. Many of the indicators presented in this report were not fully implemented, and many more were not presented because they have not been sufficiently developed and tested. To provide an assessment of the Great Lakes based on all the indicators that are necessary and sufficient, further work on the indicators will be required.

Setting Endpoints. Many of the indicators do not have an associated endpoint, target or reference value that establishes when the designation "good" can be applied to the ecosystem component being assessed. Some can be determined through planning exercises such as LaMPs and RAPs, but for others, specific research may be needed. Until such endpoints are provided, however, assessing an indicator will still be useful as it will show trends (i.e. is the condition getting better, worse or staying the same).

Monitoring, Data Collection. Without consistent monitoring or other data collection techniques directed to the suite of Great Lakes indicators, an assessment of the state of the Great Lakes basin ecosystem health will be incomplete. This issue is fundamental to measuring progress toward the goals of the Great Lakes Water Quality Agreement. Consistency in monitoring programs is important in geographic scope, timing and methods.

Data Quality. The quality of data collected and reported is important in order to influence environmental management decisions. Poor quality data can lead to erroneous conclusions about the environment and result in wasted or ill-advised managerial actions.

Information Management, Databases. Because multiple jurisdictions are involved in monitoring and data collection in the Great Lakes basin, the data are scattered widely. As the suite of indicators becomes more fully implemented, the effort required to assemble, analyze and summarize all the data may become a challenge. A deliberate system of information management for Great Lakes indicator data will facilitate rapid and accurate distribution of indicator information to environmental managers, decision makers, and other interested people.

Commitments and Ownership. For state of the Great Lakes reporting to be sustainable, commitments are required for agencies to accept lead roles to collect and interpret data and report on selected indicators prior to each State of the Lakes Ecosystem Conference (SOLEC). Data for some indicators are distributed amongst several agencies. Some agencies have accepted responsibility for preparing biennial indicator reports, and some are considering to which indicators they can commit and to which they can contribute. Many of the indicators still await "adoption," however.

Environmental Management and Programs

Non-native Species Control. In addition to causing severe disruptions to the food web, the introduction and establishment of many non-native species into the Great Lakes basin has severe negative economic consequences. Decreased spending for sport fishing and other recreational opportunities, increased costs to industry for infrastructure, and altered management plans can be anticipated as non-native species displace native ones. Non-native species control is a priority issue. Implementation and maintenance of effective control programs will reduce the risk of further invasions.

Source Controls: Point, Non-point, Agriculture, Atmospheric Emissions. Continuing loadings of contaminants and nutrients remain a problem in many areas of the Great Lakes. Sources may be point or non-point, and they may involve industrial, agricultural, municipal or other sectors of the economy. In all cases, diligence toward controlling all the sources will facilitate progress toward the goals of the Water Quality Agreement.

Drinking Water. Although the Great Lakes themselves are a good source of treatable drinking water, diligence must be taken to ensure proper treatment, and to minimize the possibility of contaminants entering the distribution system. In addition, consideration of the quality of other sources of water within the basin must be examined (i.e. river and ground water).

Infrastructure, Maintenance. Much progress has been made to reduce the quantity of contaminants and nutrients entering the Great Lakes, in part through the construction and maintenance of sewage treatment facilities, industrial processes to reduce waste, and other physical solutions. This infrastructure requires maintenance to continue efficient, effective operations.

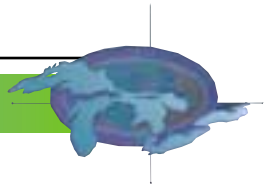
Technology Development. Some Great Lakes problems continue to be unresolved in part because of inadequate technology, e.g., complete remediation of in-place contaminated sediments and zero discharge of toxic chemicals within the Great Lakes basin. Aggressive pursuit of new devices, systems and/or methodologies will hasten progress toward the virtual elimination of toxic substances in the Great Lakes basin ecosystem.

Restoration, Protection Programs. The overall goal of the Great Lakes Water Quality Agreement is to *"restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin."* Administrative programs such as ecological preserves, zoning restrictions, parks, wildlife refuges, etc., help to maintain natural features. The application of such controls toward wetlands and terrestrial features is important for the restoration and maintenance of Great Lakes ecosystem components.

Human Population Impacts. Human populations greatly influence and modify the Great Lakes basin ecosystem. Although the problems observed in the Great Lakes can be traced to human origins, particular attention to societal pressures such as urban sprawl, energy consumption and climate change may help to reduce potentially adverse impacts.

Emerging Issues. Not all issues and concerns about the Great Lakes have been anticipated in the Great Lakes Water Quality Agreement and other planning documents. Diligence in monitoring and timely communication of findings will help ensure that government agencies and other organizations identify emerging issues quickly so that environmental management activities can be implemented. New issues may be chemical (e.g., endocrine disrupting chemicals), biological (e.g., disappearance of *Diporeia* from many lake areas), or physical (e.g., effects of water level controls).

Environmental Research. The best managerial activities are based on the best understanding of the structure and functioning of the ecosystem being addressed. Fundamental research into ecosystem processes and the impacts of new or continued stresses will assist environmental managers to best allocate resources toward resolution of identified problems. Similarly, environmental management objectives will help direct basic research toward an understanding of critical ecosystem processes.



Climate Change. Climate change scenarios have been developed for the Great Lakes basin. Projected climate changes will impact both ecological and economic systems. For instance, the possibility of lower water levels will have an impact on coastal wetlands, aquatic habitat and the shipping industry. A potentially warmer and drier climate will impact agriculture, the recreation industry (skiing) and the migration of species northward. Management plans need to be developed with these scenarios in mind.